

Ingredients

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Flavor Enhancement: Taking the Mask Off

As a food writer, I always dreaded the question, "What's hot?" When I first started in the business of analyzing ingredients and ingredient trends, I was afraid that my answer would provide conclusive proof of my inexperience. As the years passed, I came to recognize that ingredients tended to be evolutionary (not revolutionary), following their own winding paths toward new—and hopefully better—formulations.

Consequently, any answer to that dreaded question would require a detailed explanation—one that would take into consideration technological developments, current trends, health and functionality benefits, and expanding applications. Frankly, that would probably take more time than my questioner would have. Before I could fully answer it, he or she would be off asking someone else that question.

To be fair, though, to my questioner, wherever he or she may be at the moment, there are actually some ingredients that do seem to take center stage in product formulation. A few examples that I have seen over the years include antioxidants, fat replacers, healthy fats, soy, chocolate, and spices (especially those that impart higher and higher levels of heat). In the case of these ingredients, usually a number of factors have come together to place them in the formulator's spotlight.

This year, if I had to select an ingredient area that I feel deserves such a special status, it would be flavor enhancers and masking agents. My answer might surprise some

people, especially media representatives who might have chosen a *trans*-fat alternative or a low-carb ingredient or even some nutraceutical product. And I think that reaction is somewhat understandable. Traditionally, ingredients that provide flavor enhancement or masking capabilities have played an important role in food formulation, making the finished product taste better—but like enzymes, processing aids, and other such ingredients or additives, they did not always receive the attention they merited.

Today, flavor enhancers and masking agents are playing an increasingly important role in the development and reformulation of foods. It is probably safe to say that the success of many foods being developed in response to current trends depends largely on the use of appropriate flavor enhancers or masking agents.

There are a number of reasons for their growing importance. Here are just a few to consider:

- Nutraceutical applications frequently have off-notes and bitterness associated with certain sweeteners, herbs, vitamins, and minerals. Although consumers may find the health benefits of these components desirable, they may not be willing to sacrifice taste. Consequently, ingredient systems or blends have to be incorporated into the formulation to reduce or eliminate undesirable tastes, as well as provide a pleasing flavor. For nutraceutical products to be successful in the marketplace, it was essential to



Foods consist of different components which through their interactions can add or take away from any formulation. Understanding the mechanisms of taste will lead to the development of next-generation flavor enhancers and masking agents.

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develop improved flavor enhancers and masking agents. Without the nutraceutical emphasis giving it steam, most likely much of the energy behind the recent development of new flavor enhancers and masking agents might have been diverted somewhere else.

- Soy-based ingredients presented functionality challenges that the use of flavor enhancers and masking agents helped, at least in part, to solve. The use of these systems, along with other approaches, such as improved technologies and manufacturing processes and the redesigning of the soybean to reduce or eliminate undesirable traits, have allowed food manufacturers to expand the use of soy well beyond soy beverages and nutrition bars. Some emerging applications include coatings, mashed potatoes, next-generation meat analogs, bottled waters, and many others. If soy-based products are steadily moving into the mainstream, their success has a lot to do with flavor ingredient blends that helped overcome functionality problems. Without them, these applications might have ended in a backwater tributary.

- As everyone already knows, there has been a low-carbohydrate craze in the marketplace—one that has also been reflected in recent food shows. For example, at this year's All-Candy show, the dominant trend clearly was the promotion of low-carb ingredients in confections. However, taking carbs out of foods can negatively impact the taste, texture, and other sensory qualities. As in the case of fat replacement years ago, these challenges have to be met for a product to be successful in the marketplace. Unfortunately, marketing hype and oversimplification of health messages have spurred this trend along frequently without the necessary modifications to the food. One might say that the "carb was put before the horse." (I do not own the rights to that line—I heard someone say it jokingly at a food show—and it wasn't until I started writing this article that I figured out what it means, and the relevance that flavor enhancers and masking agents might have as they help to rein in some of these problems and eventually put the horse back in the right position.)

- Anyone who has read some of my past *Ingredients* sections knows that the concept of "reformulating"—making traditional foods healthier without sacrificing taste, texture, color, and other desirable attributes—keeps coming up. With the attention on low-carbohydrate

meals, soy-based products, and in general, nutraceuticals, we're already talking about reformulating to some degree. In time, hopefully that emphasis will expand to a wide range of traditional foods and beverages. Flavor enhancers and masking agents will play an obvious role in improving the taste of these reformulated products. For example, they might be used to improve the taste of some vegetables which might be more readily consumed if it wasn't for an objectionable flavor.

In a related story, the multinational New Zealand dairy company Fonterra is planning to develop a food-delivery system that would customize food at the touch of a button. The system, called POSIFoods or "point-of-sale individualized foods" would tailor snacks based on the dietary needs of individual consumers. By combining nutrition science, food processing, and formulation processes with state-of-the-art vending technology, foods would deliver a range of supplementary nutrients such as vitamin C, folate, omega-3, calcium, and antioxidants to help fight health problems such as obesity, osteoporosis, or diabetes.

According to the company, "While being able to dial up food in the way you want sounds the stuff of science fiction, this heralds the next era in food technology. Consumers will be able to receive a healthy, nutritious snack with a specified nutritional benefit and the convenience of instant vending." If such a concept catches on, it would provide opportunities for a number of ingredients, especially flavor enhancers and masking agents, which would make the nutritious snacks more desirable in taste and texture.

- There are a wide range of alternative sweeteners in the marketplace today, and generally they are being used to create better-tasting products that more and more have the functionality properties of sucrose. Some of the disadvantages of these sweeteners, such as a bitter or metallic aftertaste, are being overcome through the synergistic properties of the different sweeteners. Another alternative is the development of flavor systems to mask undesirable qualities. Consequently, the more work we see with sweeteners, the more work we'll likely see with flavor enhancers and masking agents.

- Flavor enhancers and masking agents are playing an important role in culinary preparations. To create these

products, chefs and food scientists have to understand how the different ingredients in the formulation will interact with each other. After all, when we eat a food, we're not just eating a specific ingredient, which on a blackboard or a data sheet might perform in one way, but rather we're eating a combination of components which together can enhance or detract from the formulation. An understanding of how these components work, especially from a taste and texture perspective, is essential. Furthermore, the more that prepared foods emulate the quality of culinary preparations, the more important the knowledge and the use of flavor enhancement and masking become.

- Ongoing research developments are increasing our knowledge of taste and leading to new approaches to flavor enhancement. Researchers are studying the mechanisms of taste—e.g., looking at how certain materials stimulate the trigeminal cavity, which receptors on the tongue are the most sensitive to glutamate, and how when umami substances are used in combination, their taste is synergistically amplified. Some of the new approaches and developments this research is helping to spawn in flavor enhancement will be included in this article. Also, the November 2004 *Ingredients* section will focus on ingredients for the basic senses—sweet, salty, bitter, sour, and umami—and at that time we will be looking again at some of these studies.

- Attention on high-protein foods, influenced in part by the low-carbohydrate trend, may also stimulate new studies on flavor enhancement. Amino acids, which are found in proteins, give high-protein foods their meaty, umami flavor, drawing consumers to applications containing umami substances. Examples might include tomatoes, eggs, cheese, fish products, soy sauce, and so on.

Some researchers would argue that the more they learn about umami, and, in particular, the synergism of umami substances, the more likely that information can be used in formulations to help motivate individuals to eat a healthy, balanced diet. In fact, if I may throw my two cents in, it's possible that one of the reasons that terms such as "umami" and "kokumi" (yes, there is such a buzzword now), seem so ambiguous or difficult to understand is because they take much of their meaning from synergy. And, as we have seen in the work with sweeteners,

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synergy is not always easy to explain, and not always easy to predict.

- As our population grows older and people lose their sense of taste, the use of flavor enhancers can play a critical role in creating a healthy, flavorful diet. Ongoing studies are looking closely at this area. On the other end of the life cycle, creating tastier foods for younger people can help create healthy eating habits at an early age that will hopefully take them throughout life.

- Ingredients that cause heating or cooling sensations are becoming increasingly important. (See the article, "Fiery and Frosty Foods Pose Challenges in Sensory Evaluation," on page 32 of the May 2004 issue). Understanding the challenges involved should positively impact the creation of new flavor enhancers and masking agents.

These are only some of the reasons that I think ingredients that provide flavor enhancement and masking capability are increasingly moving into the spotlight. There are other reasons as well, but I think from this quick list one can see how important flavor enhancers and masking agents are in the formulating of today's food and beverage products.

This month's *Ingredients* section will look at a wide range of new developments in the area of flavor enhancement and masking. In the following discussion, I will be analyzing flavor enhancers and masking agents together. While their functions seem to be at opposite ends, the more I study them, the more they become inextricably related. When one ingredient is suppressed, another is frequently enhanced. Or if you enhance a flavor, you might block out the qualities of another component. Ultimately, we're talking about a combination of different taste sensations and a combination of different ingredients having an impact on the taste of the finished product. Within that kind of somewhat ambiguous framework, I'm positioning the following ingredient developments. After discussing these developments, I'll look at the future of these flavor enhancers and masking agents, and try to determine to what degree they will remain in the spotlight.

Licorice derivatives and meat enhancers highlighted. Ingredients that enhance the flavor of foods while suppressing undesirable traits were highlighted at the IFT Annual Meeting + Food Expo by Wixon, Inc., 1390 E. Bolivar Ave.,

Saint Francis, WI 53235 (phone 414-769-3000; fax 414-769-3024; www.wixon.com). These natural ingredients were developed by technologists at the company, which has been known for its flavors, spices, seasonings, and technologies.

A licorice derivative, monoammonium glycyrrhizinate (MAG), potentiates sweetness, masks chemical off-notes, reduces harsh and bitter notes, and enhances other flavors. The ingredient contains the glycyrrhizin molecule, one of the active ingredients in licorice which typically constitutes 10% of pure licorice extract. In the extraction/purification process, the residual licorice taste is totally removed, leaving a pure white powder which is intensely sweet but otherwise unflavored.

According to the company, MAG can function as a masking agent while it also sweetens and potentiates other flavors, especially cocoa. When added to a carbonated diet cola, it can enhance the mouthfeel and round out the beverage's sweetener profile, eliminating the slightly metallic, artificial taste that can be found in diet beverages. MAG is said to be effective at extremely low levels—typically 40–60 parts per million. It also has multiple applications for heightening flavor and adding sweetness to bakery products such as canned frostings and puddings.

Licorice glycyrrhizates are 50 times sweeter than sucrose and 100 times sweeter than sucrose when used in conjunction with sucrose. Reportedly, they have been used extensively in European markets.

At the IFT Food Expo, the ingredients manufacturer showcased *Mag-nifique*, a complete family of all-natural licorice derivative products which are said to improve mouthfeel as well as reduce excessive sweetness, bitterness, salt, acidity, grassy notes, metallic taste, and off-notes from nutritional fortification in a wide variety of foods and beverages.

Also featured was the company's recently introduced *Wix-Fresh*, a natural flavor that extends the quality of various meat systems. The ingredient can help extend shelf life by reducing or eliminating the warmed-over flavor of meat entrees that occurs over time. Furthermore, it can mask the undesirable beany notes associated with soy. The ingredient, which is available in dry and water-soluble liquid forms, may be used in seasoning blends, vacuum-tumbled marinades, and other processing systems.

The company's latest offering was probably influenced by its work with meat enhancers, especially protein ingredients. For example, researchers at the company have developed several functional blends using proteins derived from soy, milk, and other sources, as well as starches. These blends, used in a variety of meat systems, can provide high water-binding ability, fat emulsification, and buffering capacity.

Stimulating the trigeminal cavity. A Sensoral Center of Excellence, designed to develop flavors that function in heating, cooling, tingling, and masking applications, was recently launched by Takasago International Corp., USA Flavor Div., 4 Volvo Dr., Rockleigh, NJ 07647 (phone 201-767-9001; fax 201-784-7277; www.takasago.com). The center will provide a facility for interdisciplinary research and development and flavor creation, as well as serving as a training and educational facility.

Researchers at the center study materials that stimulate the trigeminal cavity, a complex system within the human body. The term "trigeminal" refers to a pair of nerves that rise from the cerebellum and separate into three separate nerve divisions in the face, oral cavity, and nasal cavity. The system has been found to function as a key element of the body's ability to recognize and identify sensory properties of certain component of foods and substances approved for use as flavor ingredients. Takasago is a recognized leader in the creation and use of asymmetric aroma chemicals that impart stimulation to various parts of the trigeminal cavity.

With this knowledge, the company uses innovative technology coupled with application expertise to develop new lines of flavors and fragrances. For example, the company offers *Intensates™*, a line of liquid or powder masking products. These natural products have proven effective in masking many flavors or undesirable notes, including soy, artificial sweeteners, vitamins, and minerals, without sacrificing the flavor profile of the product. The center will help expand the company's capabilities in this area.

The activities of the Sensoral Center are staffed by specialized flavor chemists and applications personnel, whose efforts will be guided by input from the company's Consumer Insight and Sensory departments. New flavors and application prototypes will be created for all market segments, with special focus

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on the oral hygiene, confectionery, beverage, and pharmaceutical categories. Customers will be encouraged to work closely with the staff at the center.

In a related story, the company was issued U.S. patent 6,368,633 focusing on microparticles capable of releasing in a controlled manner olfactorily active substances. These microparticles, which have a diameter of 10–50 microns, are useful in augmenting, enhancing, and imparting aroma and taste to perfume compositions, foodstuffs, chewing gums, beverages, and other products.

The patent describes the advantages of the controlled release of olfactorily active components contained in a matrix of the microparticles, as well as a process for preparing the microparticles using adsorption of the olfactorily active material onto silica followed by a blending/extrusion step and at least one particularization step.

Developing bitter blockers and sweetness potentiators. A feature article on page 24 of the May 2004 issue of *Food Technology* focused on a biotechnological approach to the development of novel taste modifiers such as bitter blockers and sweetness potentiators. If you haven't done so yet, I highly recommend reading this article, which has strong relevance to this month's *Ingredients* section.

The article, "Taste Modification in the Biotech Era," was written by Richard McGregor of Linguagen Corp., a biotechnology company that is developing technologies that are yielding these innovative taste modifiers. The article discussed advances in understanding the science of taste, and how this knowledge—combined with biotechnology—is being used to create novel ingredients that offer advantages over traditional methods such as encapsulation or flavor-masking systems. In the July 2003 *Ingredients* section, I included Linguagen's discoveries among my list of emerging ingredients (See "Ending the Bitter End," page 78.)

Through the company's understanding of the molecular and biochemical mechanisms of taste, it has been able to discover compounds that act by blocking the perception of the bitter agent. This is much more effective in controlling bit-

terness than conventional approaches that rely on masking bitterness with sweeteners or flavor additives. The company's technology can identify the chemical compounds that impart bitterness to prepared foods, such as soups and sauces. Specific bitter blockers will improve flavor, without the need to add large amounts of salt or sugar.

Linguagen has also made major advances into understanding the perception of sweetness and creating novel compounds that will substitute for or enhance the sweetness of natural sugar. Sweetness potentiators will allow beverages and foods to be produced that contain only a small percentage of the current amount of sugar, without sacrificing taste appeal.

Symposium focused on umami and flavor enhancement. Umami, the perceived taste of glutamate, was the subject of a symposium held at the 2004 IFT Annual Meeting. The Japanese term for savory, umami is believed to be distinct from the traditional taste qualities of sweet, sour, salty, and bitter.



Studies are showing that umami substances act synergistically, amplifying their taste in foods.

The symposium, "Old Story, New Twist: Umami and Amino Acids," was cosponsored by the IFT Toxicology & Safety Evaluation Div. and Food Laws & Regulations Div., and was moderated by a representative of Ajinomoto USA, Inc. Attendees were updated on scientific research regarding the umami taste receptor; the human perception of umami; and food safety, metabolism, and the worldwide regulatory status of amino acids and umami substances.

One of the symposium's presenta-

tions addressed culinary applications of glutamate-containing flavor enhancers in product development. According to the presentation, "though Chinese gastronomes have been talking about umami for 1,200 years and Japanese researchers identified dietary components that produce the umami taste almost a century ago, and others have long characterized it using a variety of descriptors, science is just now catching up to what great cooks around the world have known: foods and flavor enhancers with glutamate can be useful in contributing a savory taste and rounding out and heightening flavors." The presentation provided attendees with information to enhance current products or formulate new ones, and learn how to develop recipes and menus featuring umami to promote maximum enjoyment in various food settings.

Another area that the symposium addressed was flavor amplification for the elderly. Inadequate dietary intake is common in the elderly, especially for those living in institutions such as nurs-

ing homes. One potential cause of inadequate intake is a loss in appetite related to an impairment of the sense of taste and the sense of smell. One strategy to compensate for the taste and smell losses is to amplify the chemosensory signals in the food. Earlier studies showed that the elderly prefer higher concentrations of taste and smell substances in foods. This presentation reported the results of a study which determined whether the addition of appropriate flavors, monosodium glutamate alone, or a combination of MSG and appropriate flavors resulted in an increased food intake, a better nutritional status, and a better quality of life in nursing home elderly.

Specialty chemicals provide cooling and flavor enhancement. Ingredients which function as cooling agents and flavor enhancers in foods and beverages are available from Millennium Chemicals, Specialty Chemicals Business, 601 Crestwood St., Jacksonville, FL 32208 (phone 904-924-2812; fax 904-768-2200; www.millenniumchem.com). Marketed under the name *WinSense*[™], these prod-

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ucts are said to provide the cooling power of menthol without the flavor, odor, or volatility.

In recent years, the company has reportedly made significant advances in the research and production of ingredients that cater to the "cooling," "refreshing," and "enhancing" trends in various food and beverage segments. According to the company, it has successfully explored technologies beyond traditional terpene chemistry through its *Winsense* product line, and is expected to offer other new commercial sensate products. Products in this line include two versions:

WS-3 is a menthol derivative, but unlike menthol, it is virtually nonvolatile, odorless, and tasteless. It also exhibits long-term stability. The product cools by eliciting responses at the trigeminal nerve endings, but the response created could be more intense than one created by menthol. In addition to cooling, the compound is observed to enhance the taste and flavor of various systems without interfering with the original flavors. Researchers are also testing the ability of the compound to elicit responses in heat-sensing channels, similar to that produced by capsaicin.

WS-23 is not derived from menthol, but like *WS-3*, this compound exhibits little or no odor or taste and low volatility. The almost odorless white powder is characterized by a high cooling activity with no side effects such as burning, stinging, or tingling sensation. It can also act as a non-interfering flavor enhancer.

While both compounds produce a cooling effect orally and topically, the cooling locations in the oral cavity are reported to vary. Some sensory researchers have found *WS-3* to cool mainly at the roof of the mouth, the back of the mouth, and the back of the tongue. They experienced *WS-23*'s cooling at the front of the tongue and front of the mouth. These observations are subjective, however, and can vary from person to person. The effects could also be dependent on the systems used and on the concentration of these cooling agents.

According to the manufacturer, studies have indicated that both compounds produced higher-intensity cooling at the onset than did other coolant molecules that were on the market in early 2002.

The company has developed prototypes which demonstrate the effectiveness of their cooling agents and flavor enhancers. For example, its sensate concepts were illustrated by a "cool" and

"refreshing" iced tea beverage and a "zesty" *Salsa con Queso* formulation. Other applications that can take advantage of the cooling agents include beer and other alcoholic drinks; nonalcoholic beverages, such as iced teas and citrus-flavored products; hard candy and other confections; dairy products; and others.

Flavor masks aftertaste of non-nutritive sweeteners. A natural flavor which improves the stability and aftertaste of artificial or high-intensity sweeteners has been developed under the name *Sucramask* by Creative Research Management (CRM), Inc., 2029 E. Harding Way, Stockton, CA 95205 (phone 209-938-0900; fax 209-938-0769; www.crmcorp.net).

The novel ingredient, which was highlighted at Food Expo, reportedly has been used in quantities of 3–15 times the amount of the sweetener to stabilize it under adverse heat and pH conditions. Additionally, the flavor diminishes or completely dissipates the aftertaste of the sweetener.

Available as a clear liquid, the easy-to-use product has a very subtle sucrose-like flavor with pleasant acidity, and is certified kosher.

Triangle taste panels demonstrated that processed, packaged, and stored beverage samples of varying pH made with aspartame, neotame, and sucralose, when supplemented with the flavor, were preferred over samples made without the flavor. The company is willing to share the results of these tests and provide product formulations that benefited the most from the use of the natural flavor.

The food research company was founded in 2001 by Cheryl Mitchell, former co-owner and co-founder of Californial Natural Products, a manufacturer of a broad range of rice-based ingredients. CRM is housed in a 26,000-sq-ft private laboratory and pilot facility that will provide independent research for the food industry. Mitchell is said to be an acknowledged expert in the development of food ingredients and specialty products made from rice, soy, pectin, and inulin, as well as being the author of more than 15 food patents and patents pending.

One area where Mitchell has done work is in the development of novel sweetener compositions containing a sugar acid in an amount sufficient to eradicate the undesired lingering aftertaste of aspartame without necessarily contributing to pulp volume. The sugar

acids may be derived from a number of sources, including pectins, alginates, synthetic polymers of uronic acids, and others. Since constituents of the food, such as flavors, proteins, fats, and carbohydrates, may mask the effect of the sugar acid, a greater percentage of sugar acid is required.

According to a company representative, "CRM's primary focus will be to help companies pursue the development and manufacture of nutraceuticals and food products utilizing low-acid aseptic processing and packaging technology. CRM is dedicated to the exploration, evaluation, testing, and development of innovative products and processes. CRM sees itself as a resource center for innovative contract food research. We'll be able to work with our clients from product concept or bench-top formulation through pilot production and provide assistance with full-scale production."

Adding kokumi to a variety of dishes. Just when you were still trying to figure out the different nuances of umami, a new buzzword is coming from Japan. It's "kokumi," a word that seems to mean a mixture of different taste or mouthfeel characteristics, including impact, mouthfulness, mildness, and taste continuity.

Flavors and seasonings are being developed which reportedly impart kokumi to a variety of dishes. A search on the Internet suggests that kokumi is a recent phenomenon, and the 2004 IFT Annual Meeting also confirms the beginnings of a possible new trend in the area of taste enhancement. With the strong Japanese influence at the Food Expo this year, it wouldn't be too surprising if this new wave gathers strength quickly as it reaches the U.S. shores.

At the show, a special flavor which adds kokumi, "a key to deliciousness," was introduced by Riken Vitamin Co., Ltd., 800 E. Northwest Hwy., Ste. 724, Palatine, IL 60074 (phone 847-705-2126; fax 847-705-7074; www.rikenvitamin.com). Called *Belex Super 1000*, the flavor is suitable for soups, sauces, dressings, snacks, and other products. At the show, the company highlighted soups made with the flavor, and invited attendees to experience for themselves what kokumi is.

Also, a new seasonings demonstrating kokumi are available from Ajinomoto Food Ingredients LLC, Country Club Plaza, West 115 Century Rd., Paramus, NJ 07652-1450 (phone 201-261-1789; fax

201-262-6871; www.ajiusafood.com). These seasonings are called *Koji-Aji* (rich in natural glutamate from wheat gluten), *Super YE* (rich in natural glutathione and nucleotides IMP and GMP), and *Ajimate Super RK* (processed flavor from Maillard reaction between sugar and natural glutathione).

U.S. patent 5,679,397, assigned to Ajinomoto Co., Ltd., Tokyo, Japan, described novel materials which impart kokumi ("richness of taste or good body") to seasonings used for foods and beverages. The patent described, in particular, a taste quality-enhancing seasoning prepared by heating a mixture of (1) gelatin and tropomyosin and/or tropomyosin peptides, (2) gelatin and paramyosin, and (3) troponin and tropomyosin and/or tropomyosin peptides, and a low-molecular-weight fraction of natural extracts. The kokumi-imparting material may be used as an alternative to other traditionally used ingredients, such as hydrolyzed vegetable proteins, hydrolyzed animal protein, and yeast extracts.

Fermented wheat protein provides umami flavor. A wheat-derived ingredient providing flavor enhancement properties is available under the name *NFE-S* from Kikkoman International, Inc., Industrial Dept., P.O. Box 429784, San Francisco, CA 94142-0784 (phone 415-956-7750; fax 415-391-1842; www.kikkoman-usa.com). Made from fermented wheat protein, it is produced using specific microorganisms and enzymes in a natural fermentation process similar to the process used to make naturally brewed soy sauce. The resulting product is then spray-dried to yield a powdered flavor enhancer that is high in amino acids, particularly glutamic acid and short-chain peptides.

The powdered ingredient, which has a neutral, light golden tan color and a mild aroma, is said to give a clean, balanced, brothy umami flavor to a variety of applications. It may be used to heighten or round out the flavors of seasoned poultry, meat products, seafood, soups, snack mixes, marinades, and other products.

Application ideas for the ingredient include *New England Clam Chowder*, *Wasabi-Flavored Potato Chip Seasoning*,

Simple Injection Chicken, *Cheesy Potatoes Au Gratin*, and many others.

According to the manufacturer, the ingredient offers excellent flavor retention during heat processing and freezing and is heat stable. The fine, free-flowing powder is instantly dispersible and soluble in water. It may be used as a replacement for hydrolyzed vegetable proteins and MSG, and can be listed on ingredient statements as "fermented wheat protein (wheat protein, salt, and maltodextrin)."

A new brochure, "A Natural Start to a Natural Label," describes the advantages of this ingredient, including functionality, labeling, and applications.

Acidulant provides masking properties. Sodium acid sulfate, marketed under the name *pHase*, is available from Jones-Hamilton Co., 30354 Tracy Rd., Walbridge, OH 43465 (phone 888-858-4424; fax 419-666-1817; www.jones-hamilton.com). The acidulant, for use in beverages and general food processing, is said to lower pH without overpowering taste. A lower percentage of the acidulant is needed to reduce pH than other conventional acidulants.

Recent studies have also determined that the acidulant is capable of masking the unpleasant aftertastes that can be associated with artificial sweeteners. Lemon-lime sodas containing the acidulant and four different sweetener systems (sucrose, aspartame, aspartame/acesulfame K blend, and aspartame/saccharin blend) were compared. Each bev-

notes of the intense sweeteners.

Taste tests were also performed on fruit-flavored waters prepared with citric acid and *pHase* at a pH of 3.2 and sweetened with aspartame. The citric acid beverages were said to have a synthetic, confectionery style of flavor with a lingering sweet aftertaste. The beverages made with the sodium acid sulfate were described as having a more natural ripe fruit pulp flavor with a bright, fruity aftertaste.

New systems enhance, mask flavors.

New flavors created specifically for use in protein-based foods and beverages are offered by Virginia Dare, 882 Third Ave., Brooklyn, NY 11232-1902 (phone 718-788-1776; fax 718-768-3978; www.virginiadare.com). Called *VidaPro*, they are said to demonstrate a special flavor delivery system that promotes quick flavor release with sustained performance. These flavors, available in a variety of types, have application in ice tea and other beverages, wellness foods such as nutrition bars, ice creams and other dairy products, snack items, and other products.

Previously, the company developed *ProSweet*, a line of flavor improvers and masking agents. These ingredient blends can reduce off-notes and bitterness associated with certain sweeteners, herbs, vitamins, minerals, and other components that can create undesirable flavors. In addition, these systems can serve as a sweetness enhancer for a variety of sweeteners, reducing harsh notes and after-

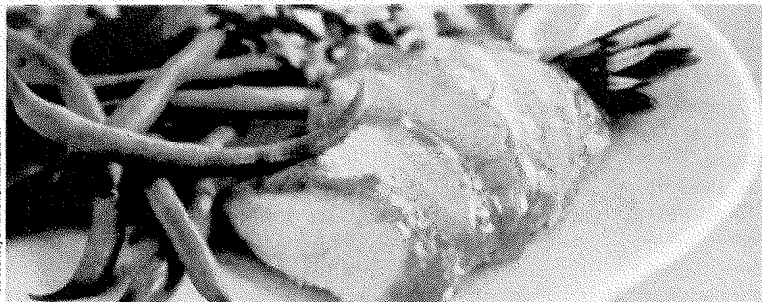
tastes while enhancing flavor.

Enhancing cooling

sensations. A high-intensity cooling technology that imparts a clean, refreshing, energizing taste and feel that invigorates flavor in beverages, confections, chewing gum, and pharmaceutical products is available from International Flavors & Fragrances, Inc., 521 W. 57th St., New

York, NY 10019 (phone 212-765-5500; fax 212-708-7132; www.iff.com).

Called *CoolTek*[™], the technology uses proprietary molecules developed through extensive research into human cold perception. It is not mint-derived, although it enhances mint flavor systems. It is also suitable for non-mint flavor systems, such as fruit, dairy, indul-



A fermented wheat protein provides flavor enhancement in a number of dishes including seasoned poultry products.

erage was adjusted to a final pH of 3.2, which required 0.14% citric acid or 0.08% sodium acid sulfate. The beverage produced with the sodium acid sulfate reportedly had a softer, cleaner taste, a more syrupy mouthfeel, and an improved aftertaste. It is proposed that since the acid flavor release of *pHase* is more delayed, this has a masking effect on the lingering

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gent, and savory flavors. The cooling sensation reportedly lasts and builds without a menthol "burn," aroma, or flavor, and without impacting other flavors in the system.

The technology has the ability to control the release of cooling—both the amount and when it is experienced—depending on the end product. Because the technology can be adjusted, customized flavor profiles can be created. The cooling intensity can be subtle or strong, giving consumers a feeling of icy freshness without saturating their cooling receptors. The company works with customers to develop the right formulation in any product, in either liquid or dry form.

According to a representative from the company, these cooling compounds not only have proven successful in confectionery products and chewing gum, but also have helped to generate new product lines such as breath films. Also, the system can be tailored for use in several types of product concepts, such as fortified flavored waters, ice tea, juices for children, and energy drinks.

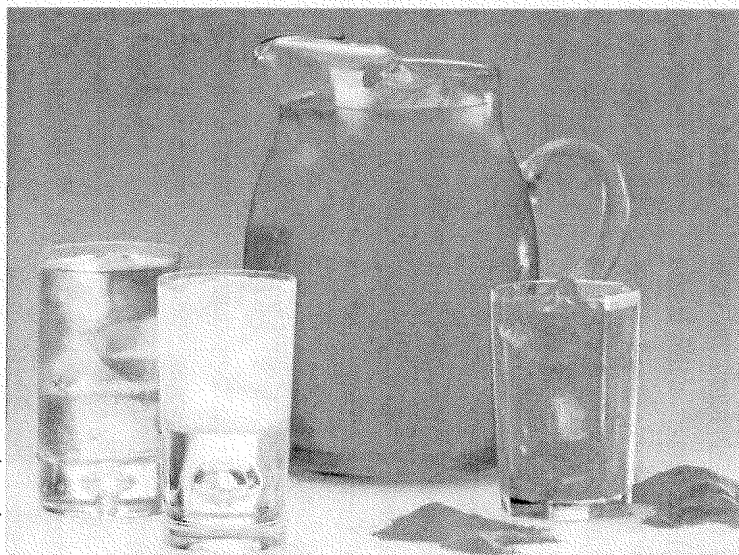
Flavor system masks bitterness associated with health ingredients. A flavor system technology for suppressing off-flavors associated with health ingredients is available from Wild Flavors, Inc., 1261 Pacific Ave., Erlanger, KY 41018 (phone 859-342-3600; fax 859-342-3610; www.wildflavors.com). Called *Resolver*®, the system can be used to improve the taste of low-carbohydrate products and other health-promoting formulations.

Derived from natural raw materials, the proprietary system can suppress many disagreeable off-notes frequently associated with soy-based products. It can also block flavor notes such as astringency, bitterness, metallic taste, and acidity often inherent in low-calorie or low-sodium products.

Emerging sweeteners have flavor-enhancement properties. The November 2003 *Ingredients* section discussed the functionality of a number of emerging sweeteners. Let's quickly look at the fla-

vor-enhancement properties of some of these sweeteners.

• Tagatose, marketed under the name *Gaio*®, is available from Arla Food Ingredients, Inc., 2840 Morris Ave., Union, NJ 07083 (phone 908-964-4420; fax 908-964-6270; www.gαιο-tagatose.com). It demonstrates synergistic properties when combined with low-calorie sweeteners, improving the taste profile and mouthfeel of the finished product made



Flavor systems may be used to provide masking in beverages formulated with alternative sweeteners.

with those sweeteners. It can function as a flavor enhancer, even at very low usage levels, and can help mask or eliminate off-tastes, bitterness, and mouth drying—qualities associated with certain sugar substitutes. It can also improve mouthfeel and color of the product.

Studies have shown that in diet soft drinks, tagatose, when blended with intense sweeteners, speeds up sweetness onset, reduces bitterness, and improves mouthfeel. In dosage levels from 0.2% to 1%, the sweetener improves the flavor profile of most high-intensity-sweetened soft drinks. Furthermore, it enhances mint and lemon flavors in sugar-free chewing gum and mints, and prolongs the sweetness of diet chewing gum. Additionally, it enhances creaminess and toffee flavor.

• Trehalose, marketed under the brand name *Ascend*™, is available from Cargill, P.O. Box 5622, Minneapolis, MN 55440 (phone 800-742-8790; fax 952-742-7440; www.cargill.com). Although it is only 45% as sweet as sucrose, it offers a

variety of functionality properties, including use as a nutritive sweetener, coloring agent, flavor enhancer, humectant, stabilizer, texturizer, and source of energy. In applications ranging from energy drinks to functional beverages, it can contribute mild sweetness while helping to enhance mouthfeel.

Incorporating trehalose as part of the sweetener system to reduce sweetness intensity can enhance the overall flavor profile of a variety of confectionery products, including caramels and toffees, chocolate systems, flavored fondants, creme, fudge, and hard candies. Off-flavors can be minimized by the sweetener in pasteurized dairy-based dessert toppings, pasteurized or aseptic puddings, and pasteurized yogurts. In chewing gum, it can be used to modify sweetness and extend overall flavor release.

• Neotame, which functions as a non-nutritive sweetener and flavor enhancer, was developed by The NutraSweet Co., 200 World Trade Center, Merchandise Mart, Ste. 936, Chicago, IL 60654 (phone 800-323-5321; fax 312-

873-5050; www.neotame.com). It is derived from and is structurally similar to aspartame, but is 30–60 times sweeter than aspartame, depending on the food or beverage matrices.

Sweetener Solutions LLC, 1209 E. Hwy. 80, Building B, Pooler, GA 31322 (phone 886-748-7177; fax 912-748-3566; www.sweetenersolutions.com), a strategic partner of NutraSweet, provides special sweetener delivery systems containing neotame in combination with a variety of sweetener blends. Blended sweeteners provide food and beverage manufacturers greater flexibility and value, including flavor enhancement, improved tastes, and better textures.

• A natural sweetener made from an isolated flavonoid of citrus (*citrus aurantium*) functions as a flavor enhancer and flavor modifier in a variety of applications. Marketed under the name *Flavex-LC*, the ingredient is produced by Arnhem Group, 25 Commerce Dr., Cranford, NJ 07016 (phone 908-709-4045; fax 908-709-9221; www.

arnhemgroup.com). The ingredient is reported to be 1,500–1,800 times sweeter than sucrose, has a synergistic sweetening effect when combined with sugar alcohols, and can be used at very low levels (1–5 parts per million). The organoleptic profile of the product can be described as having a short delay in reaching maximum sweetness perception, and a light, sweet menthol or liquorice-like aftertaste. Potential applications include confections, savory products, beverages, desserts, and nutritional products.

Seasoning has masking properties.

A seasoning with masking properties is available from Mitsubishi International Corp., 520 Madison Ave., New York, NY 10022-4213 (phone 212-605-2425; fax 212-605-1810; www.micusa.com). Marketed under the name *Enzap*, the product is made from gelatin and wheat gluten by a special hydrolysis method which reportedly prevents a lack of umami flavor and generation of bitterness.

A series of products are available in paste and powdered forms. Depending on desired characteristics, they may be derived from gelatin extracts, wheat glu-

ten, and combinations with yeast extract. The seasoning was developed by the Japanese company Dai-Nippon Meiji Sugar Co., Ltd.

Innovations in yeast extracts highlighted. A variety of yeast extracts with flavor-enhancement properties have been developed by different food ingredient companies. Here are a few examples of the most recent innovations:

- A nutritional yeast which can be used to create flavorful vegetarian dishes is available under the name *Engevita*® from DSM Food Specialties, Savory Ingredients, Valley Forge Corporation Center, 2675 Eisenhower Ave., Eaglesville, PA 19403 (phone 610-650-8480; fax 610-650-8599; www.dsm-foodspecialties.com).

The product provides a balanced source of essential nutrients, including B-vitamins, and soluble fiber. Its mild, savory flavor can be tailored toward a more roasted taste if desired. Potential applications include dietary supplements, energy bars, salad dressings, crackers, soups, sauces, and other products. The company also offers a variety of other savory product lines, including *Gistex*, a

baker's yeast extract which adds a bouillon-type brothy taste, and *Maxarome*, which combines nucleotides with a meaty, bouillon flavor for powerful taste enhancement, improved mouthfeel, and umami sensation.

- Yeast-extract-based specialty flavors for culinary applications have been developed by Savoury Systems International, Inc., P.O. Box 5487, Branchburg, NJ 08876 (phone 908-534-6621; fax 908-534-7979; www.savourysystems.com). Called *Chef Select*, the products are available as ready-to-use bases for popular entrees, or they can be specially modified. Flavors include *Rotisserie Chicken*, *Roast Garlic Base*, *Beef Gravy Enhancer*, and *Oriental Thai*, as well as several flavors for rubs.

- A series of baker's yeast extracts have been introduced under the name *ExlPrime*™ by Alltech, 3031 Catnip Hill Pike, Nicholasville, KY 40356 (phone 859-885-9613; fax 859-885-6736; www.alltech.com). Designed for use by the savory and culinary expert, the ingredients enhance flavors naturally, and are suitable for a wide range of food sys-

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tems.

- Yeast products are available under the brand name *Lyfe* by Lallemand Bio-Ingredients, 5494 Notre Dame, Montreal, QC H1N 2C4, Canada (phone 514-251-3607; fax 514-905-4246; www.lallemand.com). Two new products in the line include *Lyfe 2246 DeBittered Brewers Yeast* and *LBI LS55 Beef Broth Type Yeast Extract*. Yeast extracts may be used to enhance the flavors of meats, tomatoes, mushrooms, Cheddar cheese, and roasted notes, among others.

- Specific beef, poultry, and roasted aroma profiles are provided by baker's yeast extracts and yeast-extract-based savory flavors available from Levapan S.A., 153 #101-26, Bogota, Colombia (phone 57 1 6817474; fax 57 1 6815975; www.levapan.com). New products include *Beef Flavorin'*, *Chicken Flavorin'*, and *Roasted Beef Flavorin'*.

- Flavor-enhancing product called *Aromild* is available from Mitsubishi International Corp., 520 Madison Ave., New York, NY 10022-4213 (phone 212-605-2425; fax 212-605-1810; www.micusa.com). The product, a yeast extract rich in 5' IMP and 5' GMP nucleotides, is said to give foods a very strong taste and reduce the salty and sour tastes in foods. It can be applied to a variety of applications, including meats, vegetables, soups, sauces, drinks, and sweets.

- Low-carb yeast extracts for flavor enhancement are promoted by Accurate Ingredients, 160 Eileen Way, Syoset, NY 11791 (phone 516-496-2500; fax 516-496-2516; www.acing-iri.com). When used at a level of 0.4% in a formulation, *Ohly* yeast extract reportedly provides 0.06% carbs. The high-quality yeast extracts may be used in a wide range of savory applications.

Flavoring compound provides flavor-enhancement capabilities. A natural flavor enhancer with enzyme-inhibiting capabilities is available from MAK Wood, Inc., 1235 Dakota Dr., Grafton, WI 53024 (phone 262-387-1200; fax 262-387-1400). Called *MAK Sweet-T*[™], the natural flavoring component can achieve a variety of functions within a flavor system. In particular, it can help produce enhanced flavorings, creating better-tasting food products.

With a sweetness 2–5 times that of table sugar, the ingredient combines well with other sweeteners, considerably prolonging and enhancing their effect. It can mask the off-notes or bitter aftertaste as-

sociated with health-promoting components, such as vitamins and minerals, making the product of particular interest for functional food and beverage applications. Additionally, it can contribute to perceived mouthfeel in products with lower levels of sugar and fat.

The manufacturer says that the usage levels of the ingredient depend on the application, but suggests that a starting point similar to sugars, such as sucrose or fructose, be used.

Savory ingredients provide flavor enhancement. A line of functional flavor enhancers designed to provide a rich umami taste in prepared foods are available from Sokol and Co., 5315 Danscher Rd., Countryside, IL 60525 (phone 800-328-7656; fax 708-482-9750; www.certifiedsavory.com).

Marketed under the name *Certified Savory*[™] brand, the ingredients reportedly perform a variety of functions in a flavor system. They accentuate top notes and component flavors; improve flavor balance; provide clean, brothy, meaty flavors; stabilize the flavor in extended-shelf-life applications; and help reduce total sodium requirements. The ingredients are naturally fermented and contain a wide variety of free amino acids.

Licorice-based flavor enhancers featured. Multifunctional flavor enhancers, sweetness potentiators, and masking agents are available from Mafco Worldwide Corp., Third St. and Jefferson Ave., Camden, NJ 08104 (phone 856-968-4054; fax 856-541-8925; www.magna-sweet.com). The *Magnasweet* products, which have been marketed for more than 25 years, are formulated from licorice-based flavoring components.

According to the manufacturer, these products use the functional characteristics of licorice flavorings to produce a variety of sensory effects, including enhancing, intensifying, and potentiating flavors; augmenting or modifying sweetness perception; eliminating or minimizing bitterness and metallic aftertastes; masking unpleasant aftertastes; modifying perceived mouthfeel; and mimicking glutamate effects. The products are available in both powdered and liquid versions, allowing them to be easily incorporated in most systems. Unlike many flavorings, they are non-volatile and stable under most processing conditions. They are typically used at levels of 0.01–0.2%.

The sensory effects of these products can be attributed to their unusual tem-

poral response. The effect is generally described as slow in onset, intense, sweet, and lasting. This unique perception accounts for the ingredient's ability to enhance the duration, intensity, and character of various flavors. It also enables formulators to modify undesirable aftertastes that are bitter, astringent, or metallic.

Proteinaceous ingredient has enhancing and masking capabilities. Although it is not a new ingredient (it was first discovered in the 1840s in West Africa), thaumatin continues to be interesting primarily because of its novelty or uniqueness. It is a sweet-tasting protein extracted from the fruit of a tropical plant.

Marketed under the name *Talin*, the ingredient is available from Overseal Color, Inc., a division of The Braes Group, 1632 Livingstone Rd., Hudson, WI 54016 (phone 888-974-7575; fax 715-386-9783; www.ove-seal.com). According to the manufacturer, the ingredient has the ability to mask bitter and unpleasant aftertastes associated with soy, intense sweeteners, vitamins, minerals, and herbs; to reduce the off-notes arising during storage of food and beverage products, especially citrus; and to increase the intensity of spice, mint, and fruit flavors, producing a less aggressive, more rounded flavor profile. In addition, it can increase mouthfeel in low-fat and low-calorie products.

Multifunctional and effective at low usage levels, the ingredient is very stable to heat and pressure. It is easy to use, and combines well with other sweeteners, colors, and flavors. Potential applications include sweetener blends, confectionery products, flavor systems, beverages, chewing gum, savory and sweet products, and dairy products such as yogurts and milk drinks. It is also appropriate for diabetic products.

Salt functions as a flavor modulator. Salt has been used as a flavor modulator. In addition to imparting its characterizing taste, salt can reduce the intensity of off-flavors and provide increased flavor balance. It can also suppress off-flavors such as bitter and metallic notes and blend individual flavors.

Recent studies have confirmed the ability of salt to modulate flavors. By suppressing basic tastes—sweet, sour, and bitter—salt can actually increase the perceived intensity of other tastes or flavors. For example, by suppressing bitterness, it can allow sweetness to come

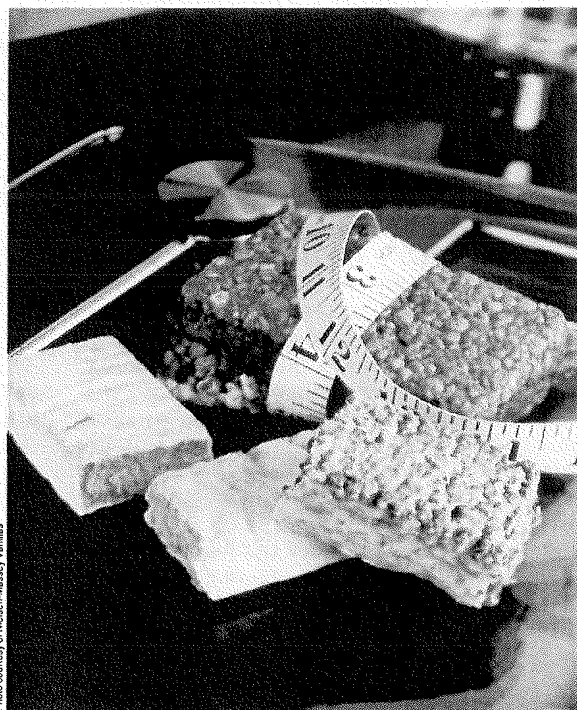
through which otherwise would be depressed by the bitterness. In chocolate, it can suppress bitterness and enhance sweetness, while contributing a sweeter, mild chocolate flavor.

Recently a kicked-up version of salt was made available by Morton Salt, 123 N. Wacker Dr., Chicago, IL 60606 (phone 312-807-2513; fax 312-807-2769; www.mortonsalt.com). Called *Morton® Hot Salt*, the new consumer product is a mix of salt, red peppers, and the smoky hot flavor of chipotle. It may be used to add flavorful heat to chicken, potatoes, hamburgers, salads, and other products. As I noted in previous *Ingredients* sections, it may also be used as an ingredient for processed foods being developed to meet trends for spicier foods.

In light of recent studies, one can't help but speculate what effect this salt would have in the area of flavor modulating. For example, at the recent All-Candy show, I saw several confectionery items made with jalapenos and hot seasonings. How about a dusting of "hot salt" and chocolate? Furthermore, it's interesting to imagine the possibilities of salt suppressing bitterness and enhancing sweetness, while adding another dimension—a little heat. Or how about the combination of honey, which can modify saltiness perception, and this new salt product, which adds heat. All of these musings seem to underline the growing importance of combinations of flavors and taste perceptions in today's and tomorrow's product formulating.

Usually, for sake of clarity, any definition for a spotlighted ingredient is provided in the beginning of an article. However, after an examination of the developments covered in this month's *Ingredients* section, I thought it might be more appropriate to hold off until this concluding section to define what flavor enhancers are.

A traditional definition for flavor enhancer would be "a substance added to supplement, enhance, or modify the original taste and/or aroma of a food, without imparting a characteristic taste or aroma of its own." Another similar definition is "natural substances which are components of proteins or cell tissue. They have no typical taste or smell,



In the future, vending-machine snacks may be customized based on the dietary needs of individual consumers. Such a novel concept would provide opportunities for flavor enhancers and masking agents.

but their presence potentiates other flavors present in the food."

Definitions such as these are scientifically accurate and remain good starting points for any discussion regarding flavor enhancers. However, the wide range of developments included in this article suggest that perhaps these definitions need to be updated somewhat to take into consideration the different approaches that a food formulator can take to enhance or mask foods and beverages.

For example, some of these substances, such as sweeteners, salt, and some flavor systems, provide flavor in addition to their ability to modify the taste of a food. And then there's the umami taste which is further amplified by the synergistic components. In addition to enhancing existing flavors, cooling agents can, of course, provide various levels of cooling. Are these levels of cooling combined with different flavors considered flavor profiles? Conversely, various ingredients are providing different levels of heat which affect flavor and may also provide flavor.

As this article has already demonstrated, much work has been done trying to understand the molecular and bio-

chemical mechanisms of taste. My guess is that the more we learn in this area, the more we may have to modify our traditional perspectives on flavor enhancers, including their definitions.

Furthermore, while the definitions agree that flavor enhancers modify tastes, it may not be that simple. More studies are looking at the synergistic abilities of flavor-enhancing substances, and how these abilities amplify flavor enhancement. It may be that in this area, $1 + 1 = 3$. Future studies will underscore how these synergies work. It's also quite possible that when you hear someone talk about umami taste, you might be actually be talking about synergy.

Also, traditional definitions do not consider the effects of flavor enhancement in the formulation. By enhancing one flavor, another flavor may be masked. By suppressing one component, you may be enhancing another. The relationship between flavor enhancement and flavor masking may be very interrelated. For that matter, taste sensations—sweet, salty, bitter, sour, and umami—may be very inter-related as well. Combinations such as sweet and salty, salty and sour, cool and sweet, hot and umami, and countless others are all possible, with flavor enhancing and masking right in the middle.

Why is all this important? Because as the definitions begin to recognize these different developments and their complex relationships, I think we will begin to better understand the importance of ingredients that provide flavor enhancement and masking in future formulations. We will be better able to visualize a vegetable that doesn't have an undesirable taste. A breeding system made with soy. A vending machine snack that is rich with vitamins, but is also delicious. A low-carb candy that uses sweeteners that have a rich sweet taste. A food that an elderly person can taste. And the possibilities go on and on. ●

Next month, ingredient developments shown at the 2004 IFT Food Expo will be highlighted.